Ordering number: EN 395F

Monolithic Digital IC

SANYO No.395F

LB1405,1415

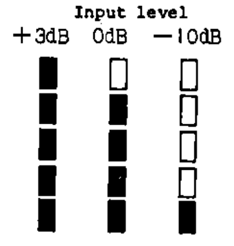
Level Meter

Use

- AC level meters such as VU meters.
- DC level meters such as signal meters.
- Supply voltage (battery, etc.) detection meters.

Features

(1) 2 types of LB1405/1415 available depending on comparator.
(2) Bar-shaped display of input level with 5 LEDs (see right.)
(3) Built-in LED direct drive output of constant current that supply voltage regulation causes no variation of LED current.
(4) Wide recommended supply voltage range : 4.4 to 12.0 V
(5) Various uses enabled by built-in DC amplifier (30dB) : 4.4 to 12.0 V
(6) Lighting/unlighting response time variable with an external resistor, capacitor.
(7) No variation of display output owing to built-in constant voltage circuit even in case of supply voltage regulation.
(8) High input impedance.



[Example of VU level meter]

Comparator Level at Ta=25°C, V_{CC}=6V, Iref=5mA, See specified test circuit.

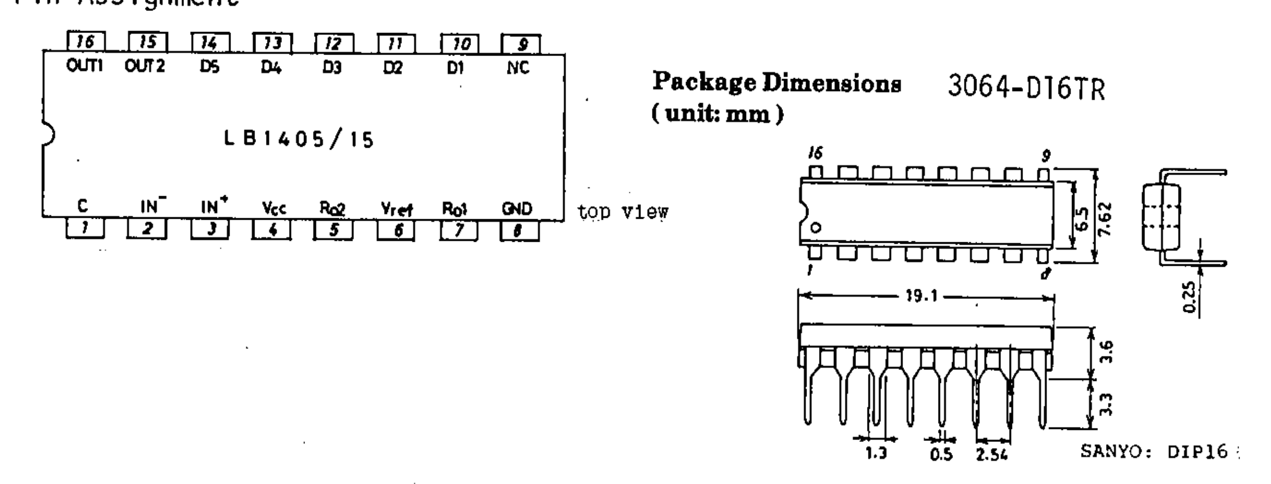
Comparator Level	Symbol	Pin No.	Conditions	LB1405 min	LB1405 typ	LB1405 max	LB1415 min	LB1415 typ	LB1415 max	unit
D5	GD_5	Pin 14	V_{RO2}=2.6 to 3.0V, V_{RO1}=0V	1.6	2.0	2.4	5.5	6.0	6.5	dB
D4	GD_4	Pin 13	V_{RO2}=2.6 to 3.0V, V_{RO1}=0V	-0.4	0	0.4	2.5	3.0	3.5	dB
D3	GD_3	Pin 12	V_{RO2}=2.6 to 3.0V, V_{RO1}=0V	-3.6	-3.0	-2.4	-0.5	0	0.5	dB
D2	GD_2	Pin 11	V_{RO2}=2.6 to 3.0V, V_{RO1}=0V	-8.0	-7.0	-6.0	-6.0	-5.0	-4.0	dB
D1	GD_1	Pin 10	V_{RO2}=2.6 to 3.0V, V_{RO1}=0V	-17	-15	-13	-12	-10	-8	dB

[Definition of 0dB]

LB1405 2.37V at OUT2 is taken as 0 dB. (Voltage of R_{O2}:3V, voltage of R_{O1}:0V)

LB1415 1.50V at OUT2 is taken as 0 dB. (Voltage of R_{O2}:3V, voltage of R_{O1}:0V)

Pin Assignment



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Absolute Maximum Ratings at Ta=25°C

Max. Supply Voltage	$V_{CC}max$	Pin 4	-0.3 to 14	V
Input Voltage	V_{IN}	Pin 2, 3	-0.3 to 14	V
Terminal C Current	C_I	Pin 1	-0.1 to 2.0	mA
Output Voltage	$V_{OUT(1)}$	Pin 16	-0.3 to 12*	V
	$V_{OUT(2)}$	Pin 15	-0.3 to 12	V
	V_{OUT}	Pin 10 to 14	-0.3 to 14	V
Reference Current	I_{ref}	Pin 6	0 to 10	mA
Allowable Power Dissipation	$P_d max$	Ta=55°C(whole package)	500	mW
Operating Temperature	Topr		-10 to +60	°C
Storage Temperature	T_{stg}		-40 to +125	°C

* Output terminal OUT1 is OFF and OUT2 is connected to pin 8 (GND) through 12kohms.

(Note) Do not apply more than (V_{CC}+0.3V) to input and output pins.
(Be careful particularly when turning ON supply voltage.)
If no LED is connected to D1 to D5, connect these terminals to VCC.

Operating Conditions at Ta=25°C

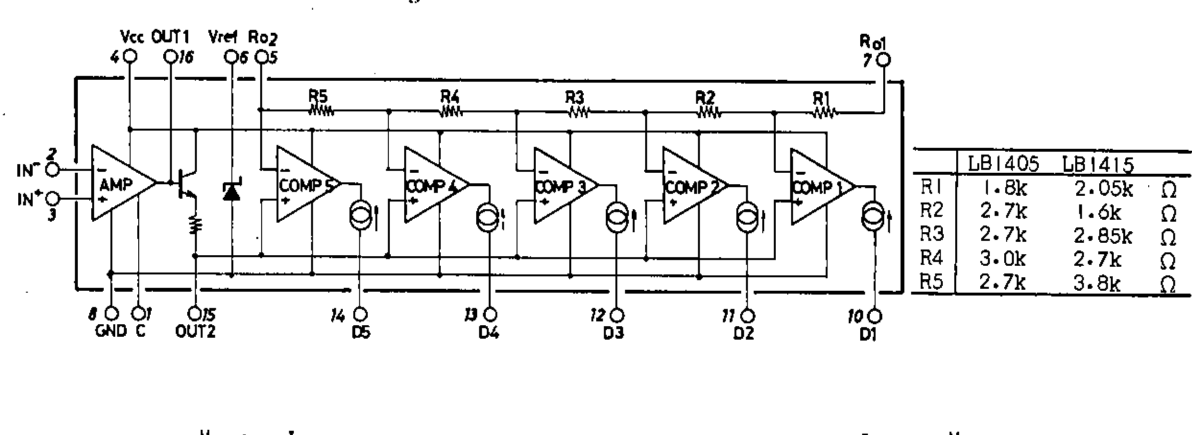
Supply Voltage	V_{CC}	Pin 4	4.4 to 12	V
Reference Current	I_{ref}	Pin 6	2.5 to 9	mA
Output 2 Load Resistance	R_L2	Pin 15	15 to 20	kohm(Insert between OUT2 and GND.)

Electrical Characteristics at Ta=25°C,V_{CC}=4.4 to 12V,See specified test circuit.

				min	typ	max	unit
Input Bias Current (Amplifier)	I_{IN}+(A)	Pin 2	V_{CC}=12V,V_{IN}+=10V,V_{IN}-=0V, I_{ref}=5mA	-2		0	µA
	I_{IN}-(A)	Pin 3	V_{CC}=12V,V_{IN}+=0V,V_{IN}-=10V, I_{ref}=5mA	-2		0	µA
Input Bias Current (Comparator)	I_{IN}+(C)	Pin 5,7	V_{CC}=12V,V_{IN}+=10V,V_{IN}-=0V, V_{RO1}=0V,V_{RO2}=0V,I_{ref}=5mA	-10		0	µA
	I_{IN}-(C)	Pin 15	V_{CC}=12V,V_{IN}+=0V,V_{IN}-=10V, V_{RO1}=V_{RO2}=V_{ref},I_{ref}=5mA, V_{OUT2}=0V	-10		0	µA
Reference Voltage	V_{ref}	Pin 6	I_{ref}=2.5 to 9.0mA	2.6		3.0	V
Amp Offset Voltage (Amplifier)	V_{offset}	Pin 15	I_{ref}=5mA,Amp gain=20dB	-500		+500	mV
Output Flow-in Current OUT1	I_{OL}(1)	Pin 16	V_{OUT1}=0.5V,V_{IN}+=0V,V_{IN}-=4V,I_{ref}=5mA	0.2			mA
Output Flow-out Current OUT1	I_{OH}(1)	Pin 16	V_{OUT1}=3.7V,V_{IN}+=4V,V_{IN}-=0V,I_{ref}=5mA			-20	µA
Output Flow-out Current OUT2	I_{OH}(2)	Pin 15	V_{CC}=4.4V,V_{OUT2}=0V,I_{ref}=5mA			-3.1	mA
	I_{OH}(2)	Pin 15	V_{CC}=12V,V_{OUT2}=0V,I_{ref}=5mA			-7.0	mA
Output Flow-in Current D1 to D5	I_{OL}(D)	Pin10 to 14	V_{CC}=4.4V,V_{D1} to 5=2.3V, V_{IN}-=0V,I_{ref}=5mA,V_{IN}+=3V,V_{RO2}=3V	3		7.5	mA
	I_{OL}(D)	Pin10 to 14	V_{CC}=12V,V_{D1} to 5=9.7V, V_{IN}-=0V,I_{ref}=5mA,V_{IN}+=9V,V_{RO2}=9V	3		7.5	mA
Output Leak Current D1 to D5	I_{OH}(D)	Pin10 to 14	V_{CC}=12V,V_{IN}+=0V,I_{ref}=5mA, V_{IN}-=9V,V_{RO2}=9V			50	µA
Current Dissipation	I_{CC}	Pin 4	V_{CC}=12V,V_{IN}+=0V,V_{IN}-=10V, I_{ref}=5mA		8	15	mA
Amp Gain	VG		Open loop	30			dB

(Note) Direction of current
Plus (no sign):Flowing into IC
Minus (-): Flowing out of IC

Equivalent Circuit Block Diagram



	LB1405	LB1415	
R1	1.8k	2.05k	Ω
R2	2.7k	1.6k	Ω
R3	2.7k	2.85k	Ω
R4	3.0k	2.7k	Ω
R5	2.7k	3.8k	Ω

V_{ref} - I_{ref}

Ta=25°C, Vcc=6V

Reference Voltage, V_{ref} - V / Reference Current, I_{ref} - mA

I_{LED} - V_{CC}

Ta=25°C, Iref=5mA, V_F(LED) =2.1V

LED Current, I_{LED} - mA / Supply Voltage, V_{CC} - V

V_{ref} - T_a

Vcc=6V, Iref=5mA

Reference Voltage, V_{ref} - V / Ambient Temperature, T_a - °C

I_{LED} - T_a

Vcc=6V, Iref=5mA

LED Current, I_{LED} - mA / Ambient Temperature, T_a - °C

Comparator Level - T_a

D5, D4, D3, D2, D1

LB1405, Vcc=6V, Iref=5mA

0dB=2.37V

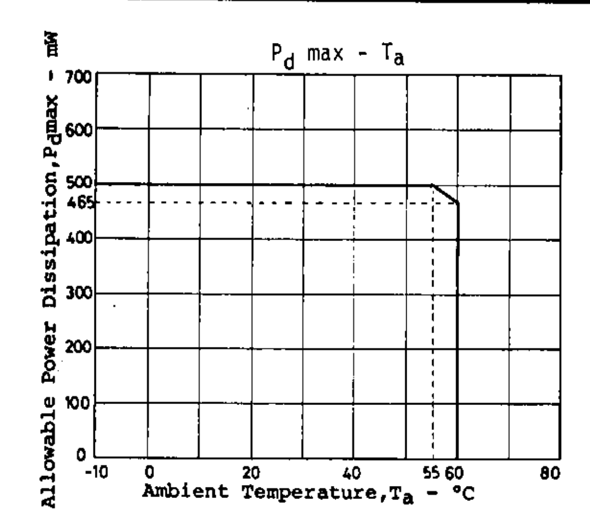
Comparator Level - dB / Ambient Temperature, T_a - °C

VG - f

Amp. gain=20dB

C2=47u, C2=4.7u, C1=15p, C1=120p

Voltage Gain, VG - dB / Frequency, f - Hz



Proper cares in using the IC

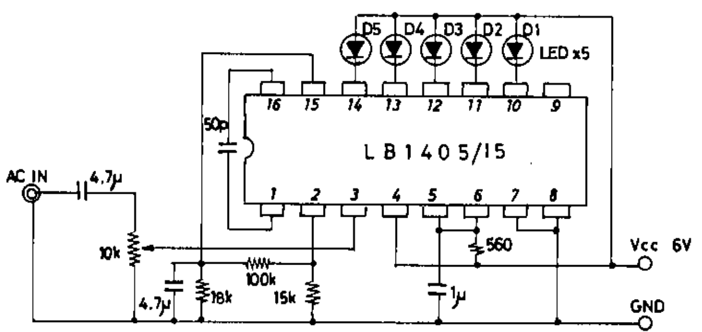
- If D output is not used, connect it to V_{CC}.
- Apply current to Vref whose voltage is used inside the IC.

Sample Application Circuits

Unit (resistance: Ω, capacitance: F)

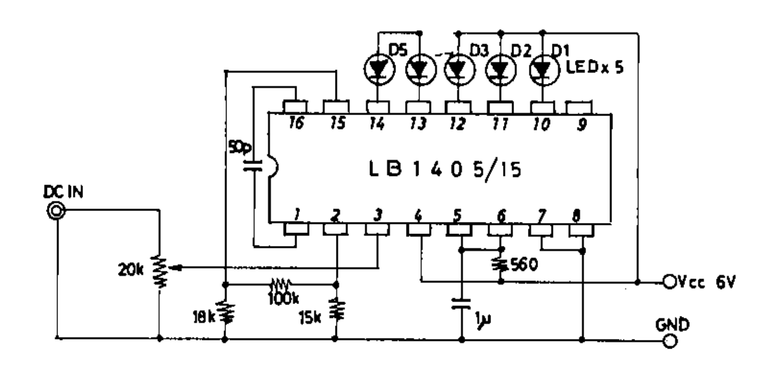


1. VU meter

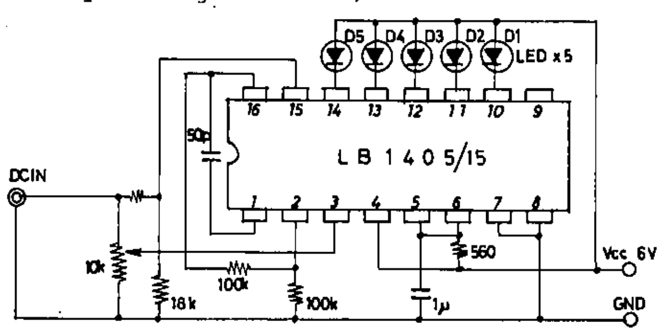


- Adjust 0dB point with the semifixed resistor of input. (The same applies in the following cases.)

2. Signal meter

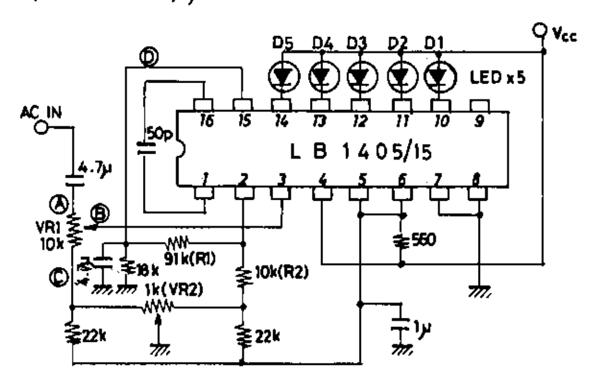


3. Zero point shift (battery voltage checker)



Unit (resistance: Ω, capacitance: F)

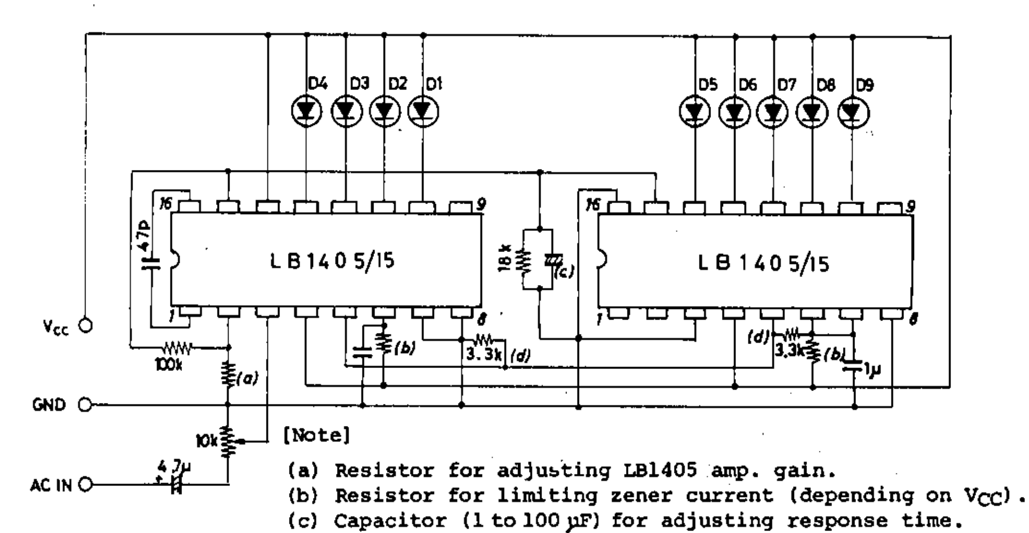
4. Offset adjust circuit (VU meter))



Adjusting procedure
1. Set VR1 to Ⓐ.
2. Make AC IN quiescent.
3. Apply DC 50mV across pins Ⓑ and Ⓒ.
4. Adjust VR2 so that voltage on pin Ⓓ becomes 500mV.
5. Remove voltage applied across pin Ⓑ and Ⓒ.

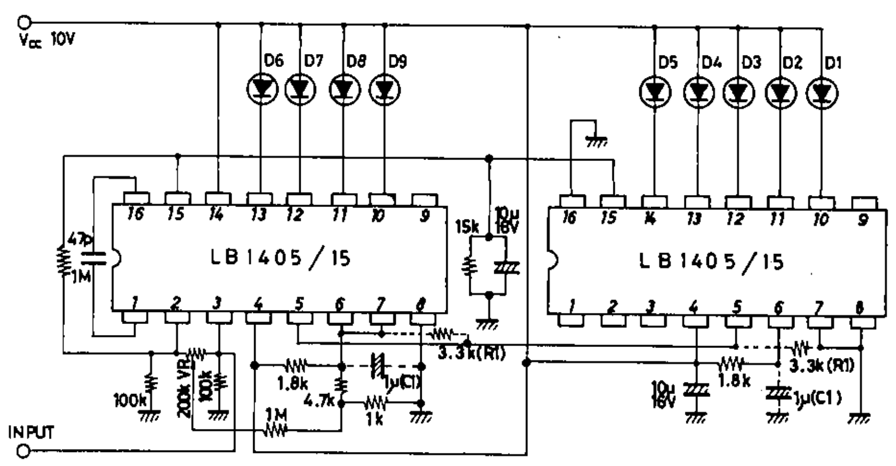
Note: Voltage on pin Ⓓ is 500mV x $\frac{R1+R2}{R2}$.

5. Display of 9 LEDs (1)



[Note]
(a) Resistor for adjusting LB1405 amp. gain.
(b) Resistor for limiting zener current (depending on V_{CC}).
(c) Capacitor (1 to 100 μF) for adjusting response time.
(d) For adjusting variation of comparator level between 2 ICs.

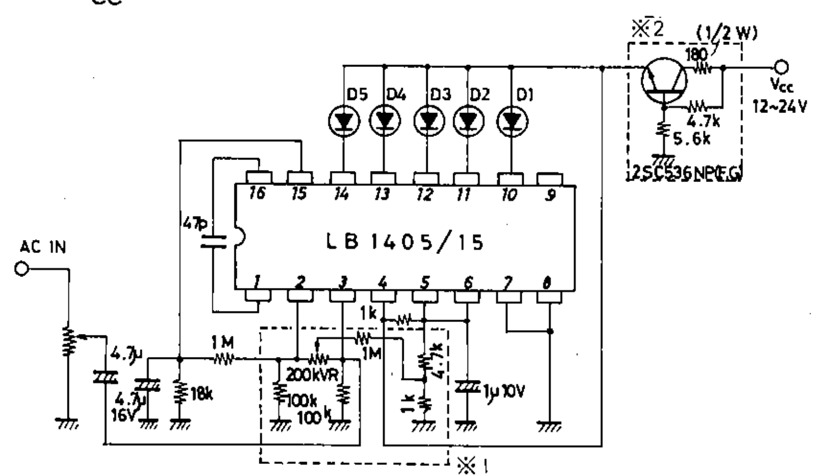
6. Display of 9 LEDs (2)



Note VR: For adjusting offset voltage
C1: Desirable to use for preventing oscillation of V_{ref}.
R1: Desirable to use for adjusting variation of comparator level between 2 ICs.

7. VU meter used at V_{CC}=12 to 24 V

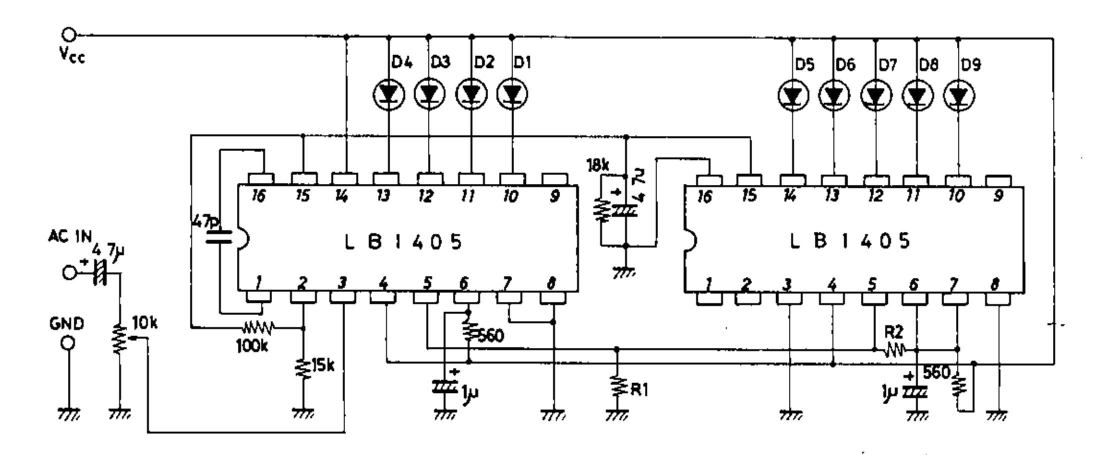
Unit (resistance: Ω, capacitance: F)



※1 Offset adjust circuit of input amp.
※2 Circuit for dropping supply voltage applied to IC.

8. Cascade connection
This is an example of cascade connection where external resistors are used between R_{01} and R_{02}.
The comparator level is mainly described. For offset adjust circuit of input amp, refer to 4 or 7.

. 2-pc. cascade connection



1) Comparator level at $R_1=R_2$≒3.3k (Error of resistance ratio of R_1, R_2 is desirable to be less than 1%.)

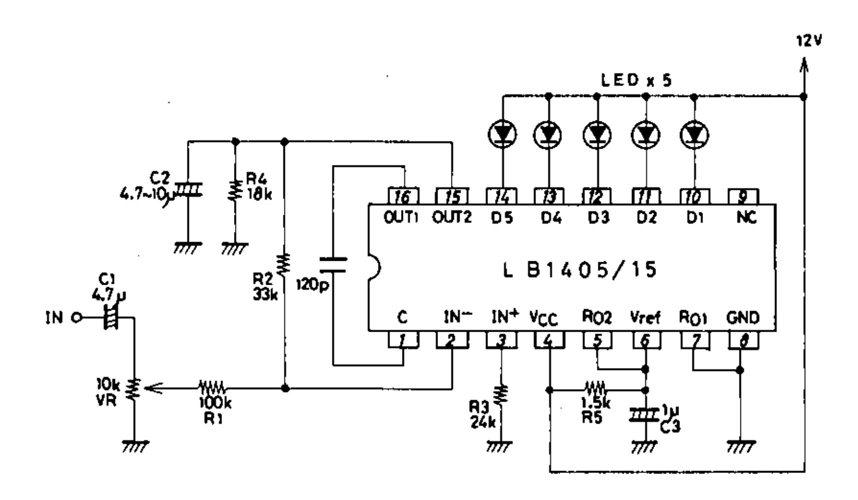
LED No.	D1	D2	D3	D4	D5	D6	D7	D8	D9
dB (typ.)	−19	−11	−6.5	−3.7	−1.6	0	+1.5	+2.7	+3.7

2) Comparator level at R_1=3k,R_2=2k (Error of resistance ratio of R_1, R_2 is desirable to be less than 1%.)

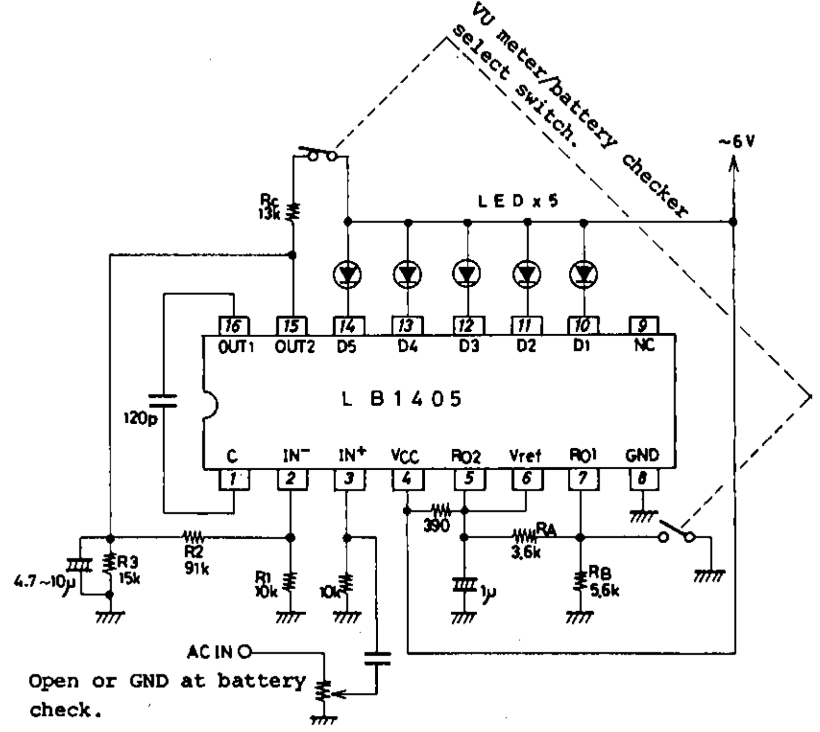
LED No.	D1	D2	D3	D4	D5	D6	D7	D8	D9
dB (typ.)	−18	−10	−6.5	−3	−1.2	0	+1	+2	+3

Unit (resistance: Ω, capacitance: F)

9. Circuit where speaker output of audio amp is input
.Full scale at 7 V_{rms} input



10. Circuit for both VU meter and battery checker (6V set)



Operation at battery check (Error of R_A,R_B is 5% considering variation of IC.)

Lighting-on Level	Battery voltage min	typ	max	unit
D_1 lighted	3.5	4.0	4.5	V
D_2 lighted	3.9	4.4	4.9	V
D_3 lighted	4.3	4.8	5.3	V
D_4 lighted	4.7	5.2	5.7	V
D_5 lighted	5.1	5.6	6.1	V

If R_C,R_B are adjusted as semifixed resistor, error will be further reduced.